Analytics Vidhya

Harnessing ML and NLP for Elevated Customer Experiences

The DataHour

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Lead ML Scientist, Loris

March 2024

About Me

- Lead ML Scientist at Loris
- Host of Learning from Machine Learning Podcast
- M.S. Computer Science
- B.A.S. Complex Human Behavior and Evolution

Agenda

- What is Loris?
- What ML & NLP Challenges do we face?
- Topic Modeling using BERTopic
- Text Classification with SetFit
- Evaluating ML Models
- Demo
- Takeaways
- Q&A

Loris

What is Loris?

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Company Highlights

Clients Include:

FINTECH	flex. bill zip
TECH	fiverr slice
TELECOM	mintmobile ultra mobile
ECOMM	THESIS BARK BOX
BPOs	horatio redial

Investors Include:

FLOODGATE

vertex VENTURES

homebrew


Jeff Weiner
(LinkedIn)

bowcapital

servicenow

NYC, TLV
Offices

2018
Founding

>200M
interactions analyzed

6 continents
Global

Loris

QA (1%)

The Problem

Every company's greatest asset is its most underutilized

Billions of customer interactions contain a goldmine of untouched insights

Surveys (9%)

The Solution

We use AI to transform every customer interaction into an opportunity for insights, optimization and growth

Loris' Approach

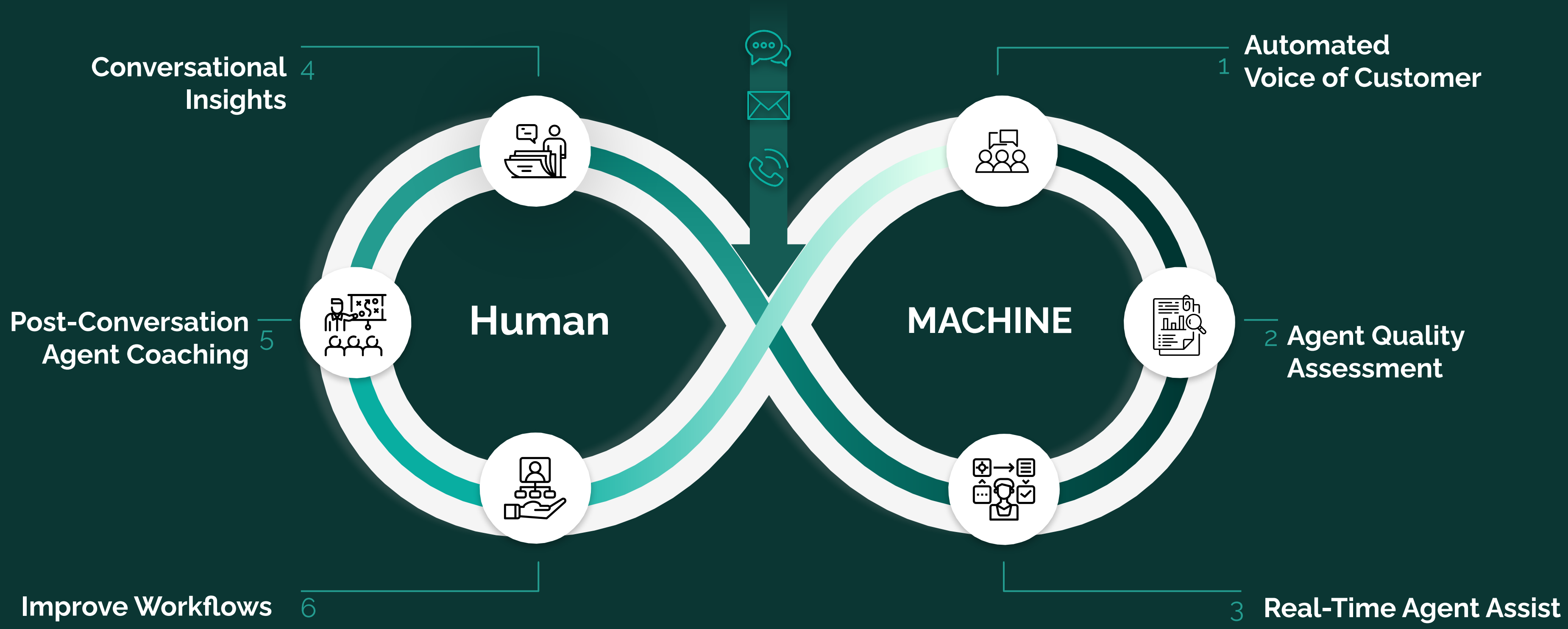
Insights

- The challenge is modeling a domain to solve its specific problems
- Foundation models are becoming a commodity (both commercial and OS)
- Understanding the domain and gathering the right data is a differentiator

Approach

- Model the domain of customer support conversations (conversation phases, dialog acts, etc.)
- Use proprietary data to optimize models for customer support (e.g., Customer Sentiment, Conversation Markers)
- Develop customized Contact Driver models for clients
- Enable a feedback loop on how users interact with our product and predictions

Loris Combines the Best of Humans ∞ MACHINE



Improve customer experience, operational efficiency, and insight

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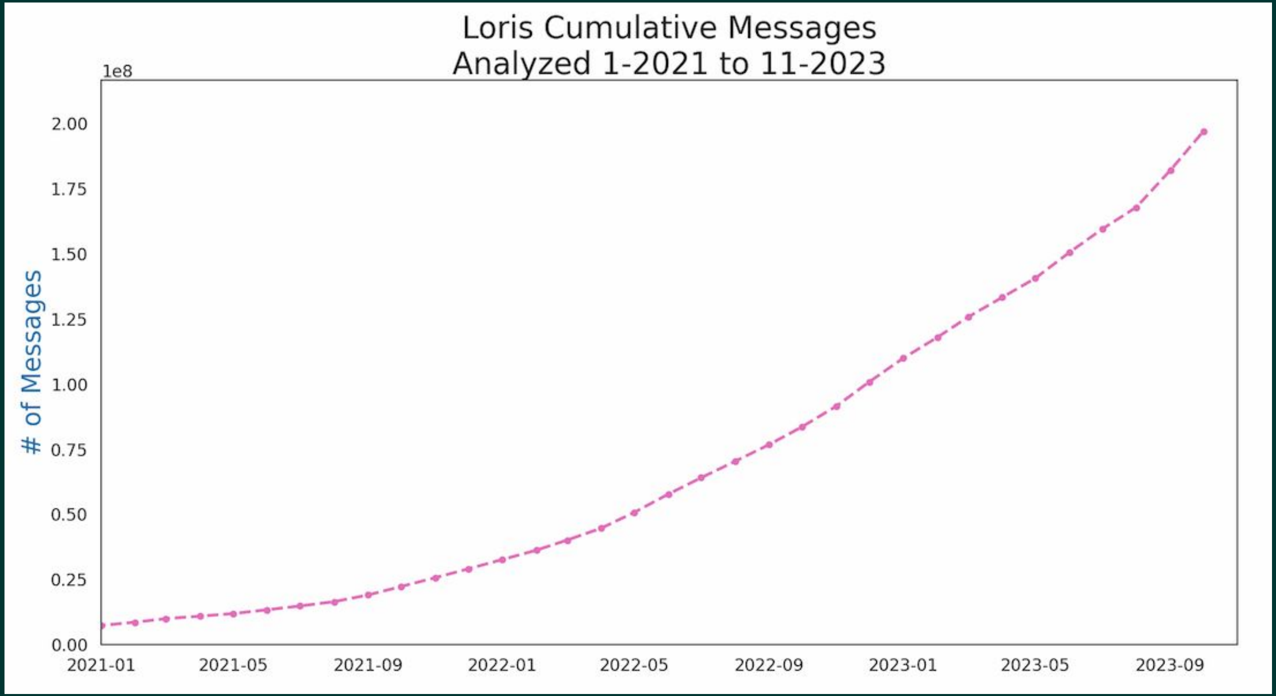
Our Platform is Scaling Fast



Over 200 million customer care messages analyzed
Analyzing over 5 million messages per month

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Omni-Channel

Chats

Emails

Messaging Apps

Phone calls

State of Machine Learning

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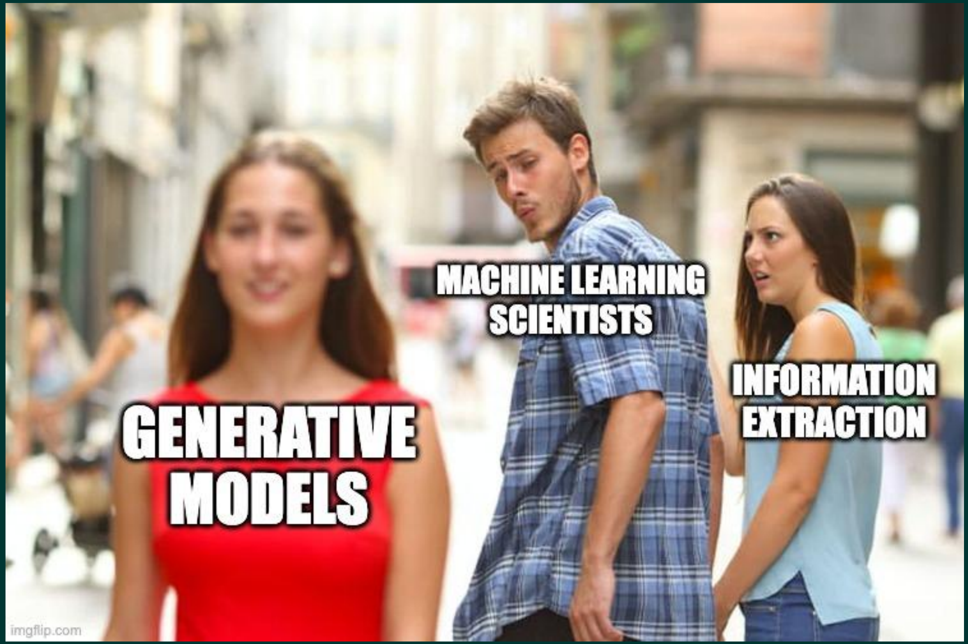
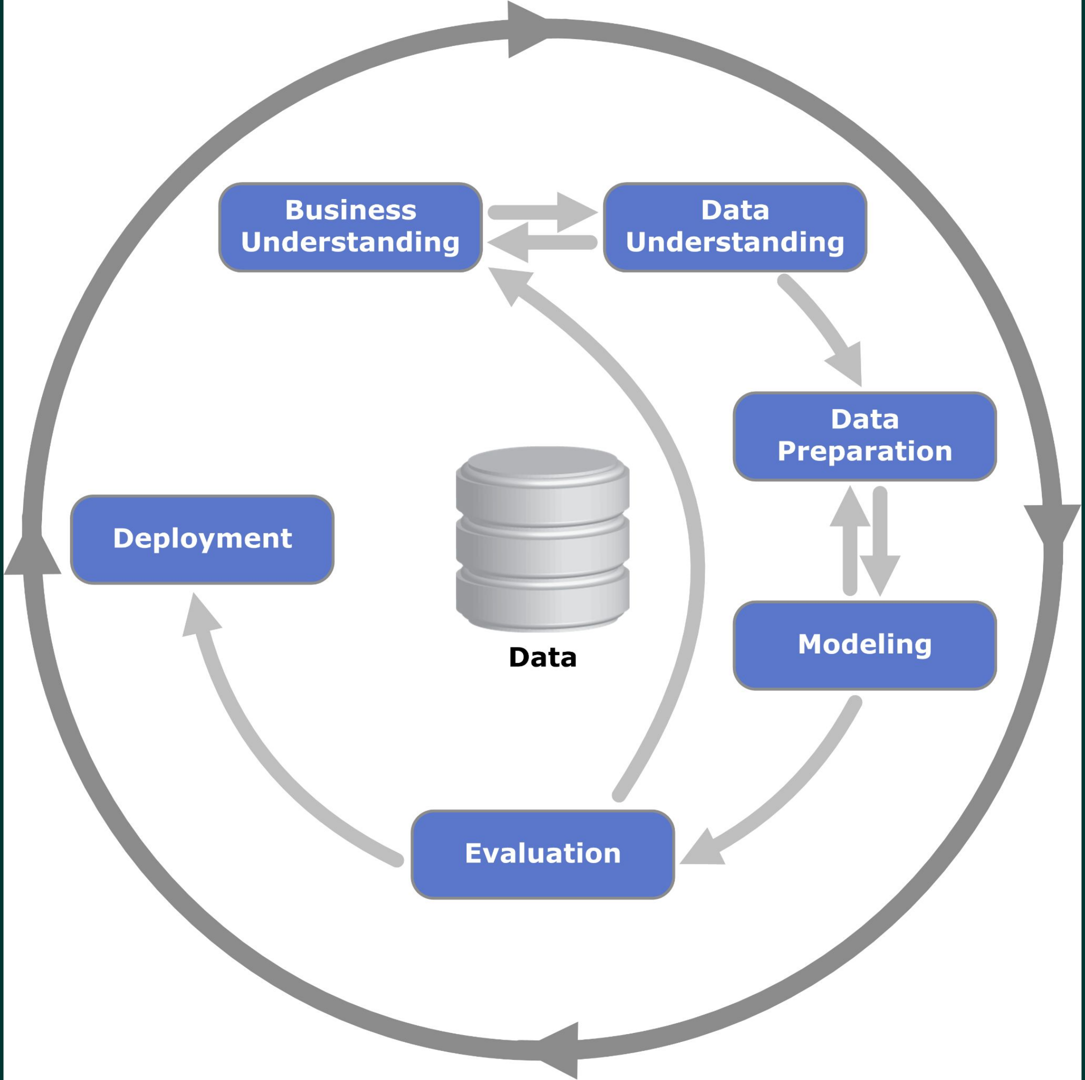
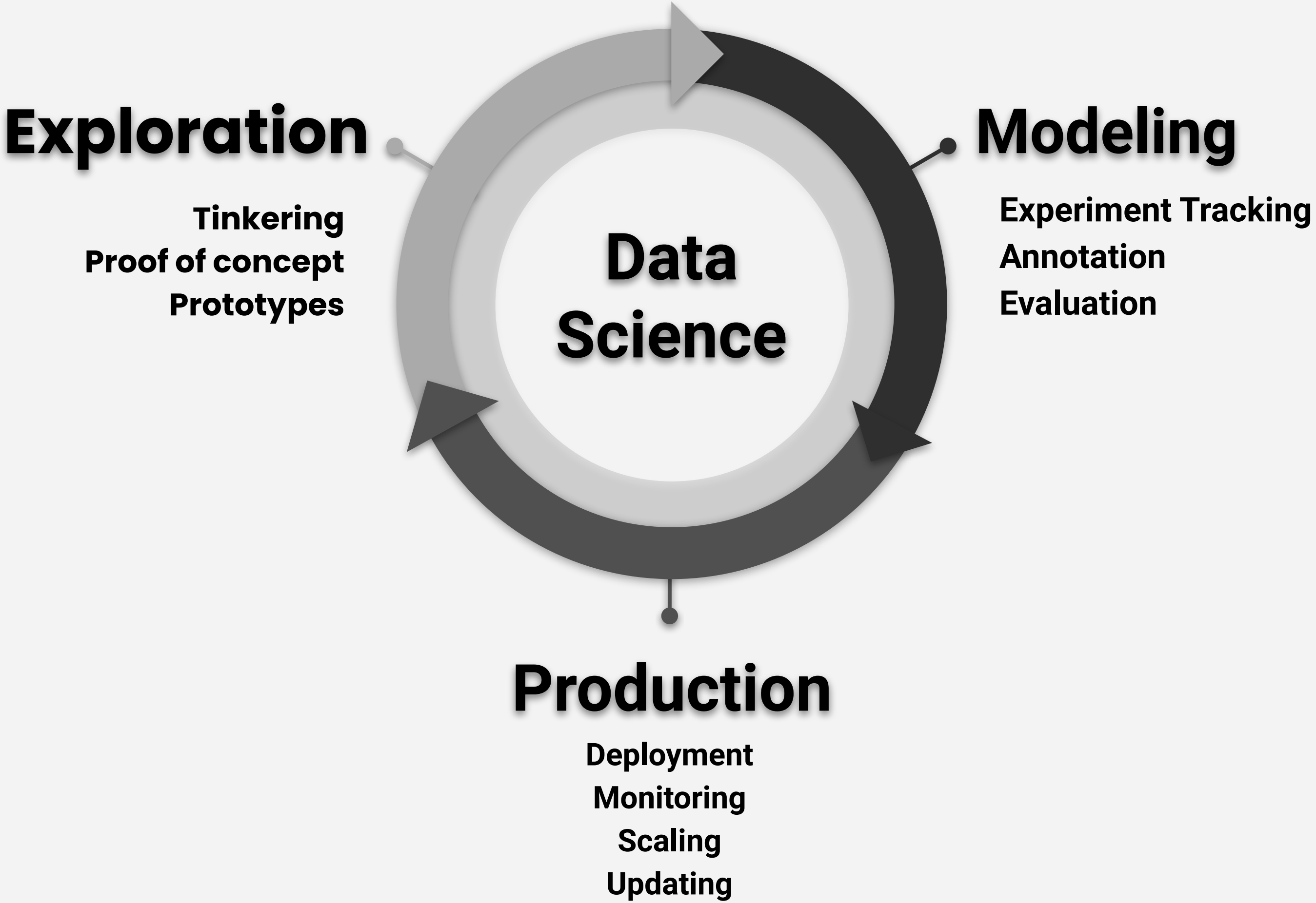
How have ChatGPT-like models changed our approach?





[Cross-industry standard process for data mining - Wikipedia]


Exploration
Tinkering
Proof of concept
Prototypes
Data Science
Modeling
Experiment Tracking
Annotation
Evaluation
Production
Deployment
Monitoring
Scaling
Updating

Machine Learning and NLP at Loris

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Main Questions

How is the customer feeling?

+

Why did the customer contact the company?

+

How did the conversation go?

Conversation Modeling and Intelligence

Loris Generalized Models

Message-Level

- Sentiment Model
- Sentiment Target
- Conversation Markers
- Profanity
- Polite Refusal
- Question Detection
- ...

Conversation-Level

- Conversation Quality (CQ)
- Summarizer
- Resolution
- Agent Actions

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Loris Custom Client Models

- Client-specific text classification models that each client can use to understand their customers' reason for contact (or intent)

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Underlying Need

What problem are we trying to solve?

- Identify what the conversation is about
- Understand a company's contact drivers

Knowing the contact driver of a conversation allows Loris and our clients to segment conversations into meaningful groups for improvement opportunities

The ability to interpret what a customer is looking for no matter how they word the request

Company can analyze trends, route, create and improve workflows

Intent Frequency Over Time

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Intent Frequency Over Time

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Evaluation

Coverage: % of conversations that are assigned 1 or more intent(s)

Precision: Fraction of detected intents that are correctly predicted

- When an intent is predicted, is it correct?
- Examined on the class-level

Frequency: In historical data, does the frequency of each contact driver make sense to clients?

- Proxy for recall on the class-level

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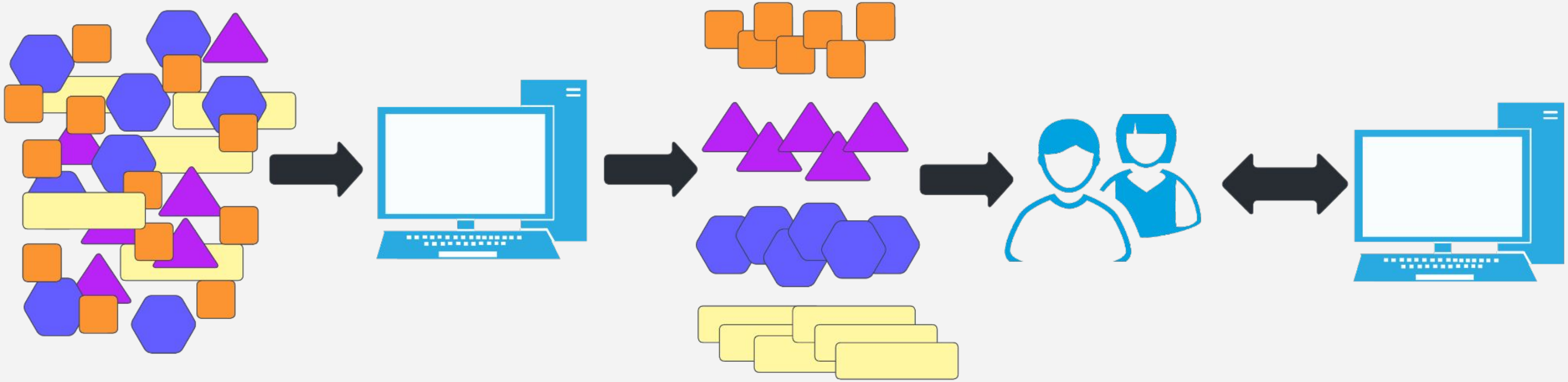
Topic Modeling supports Text Classification

Unsupervised Learning supports Supervised Learning



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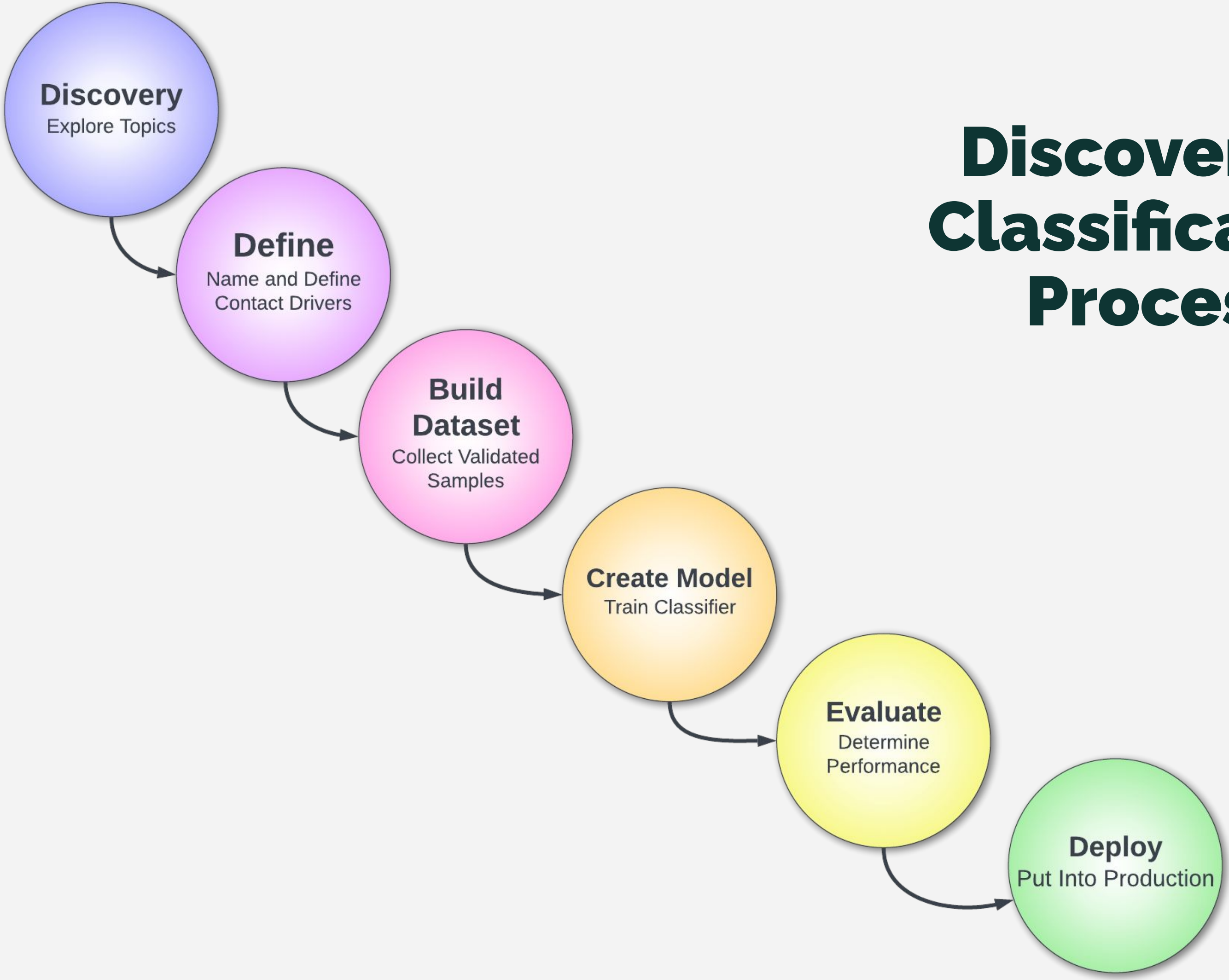

Discovery & Classification Process

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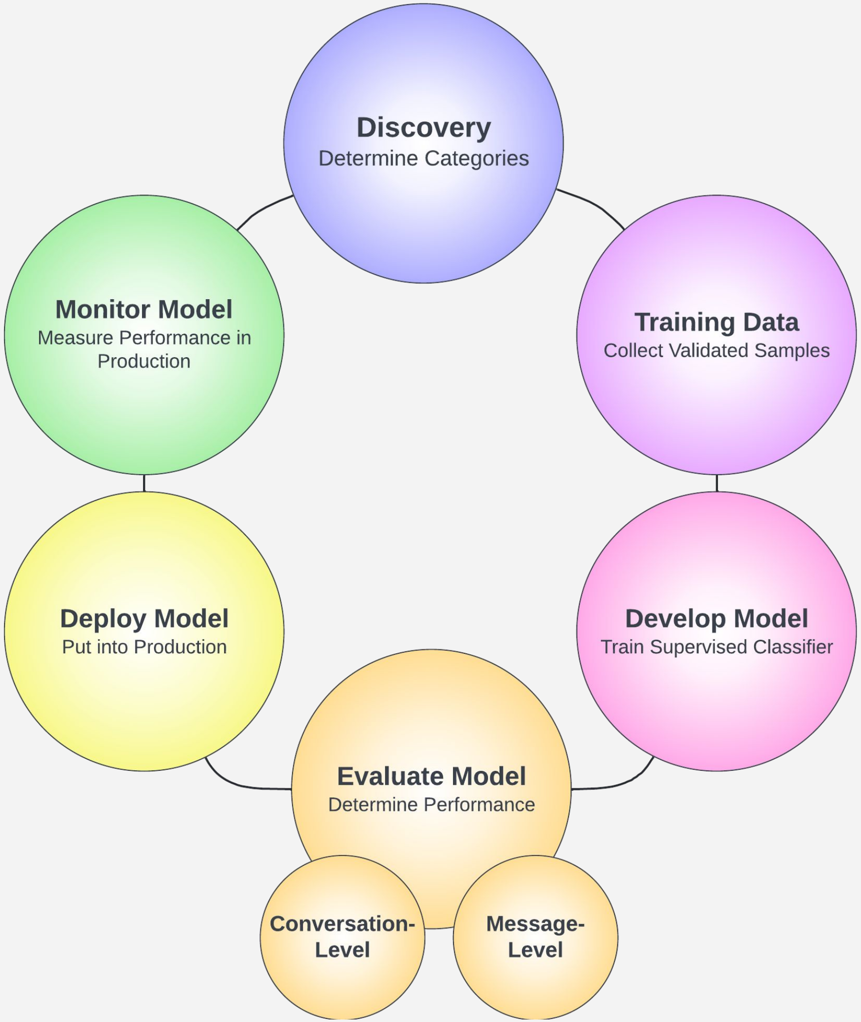
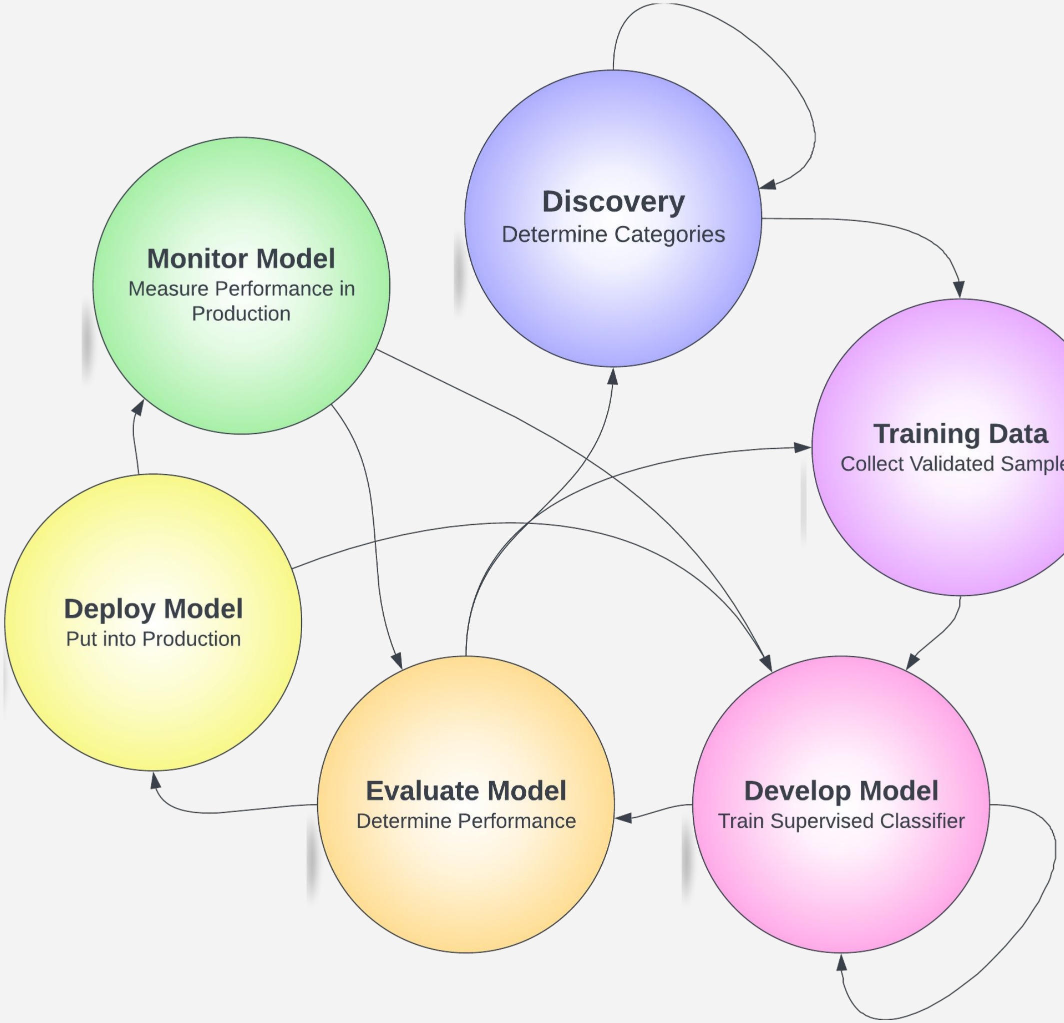
Discovery and Classification Process



Discovery and Classification Process



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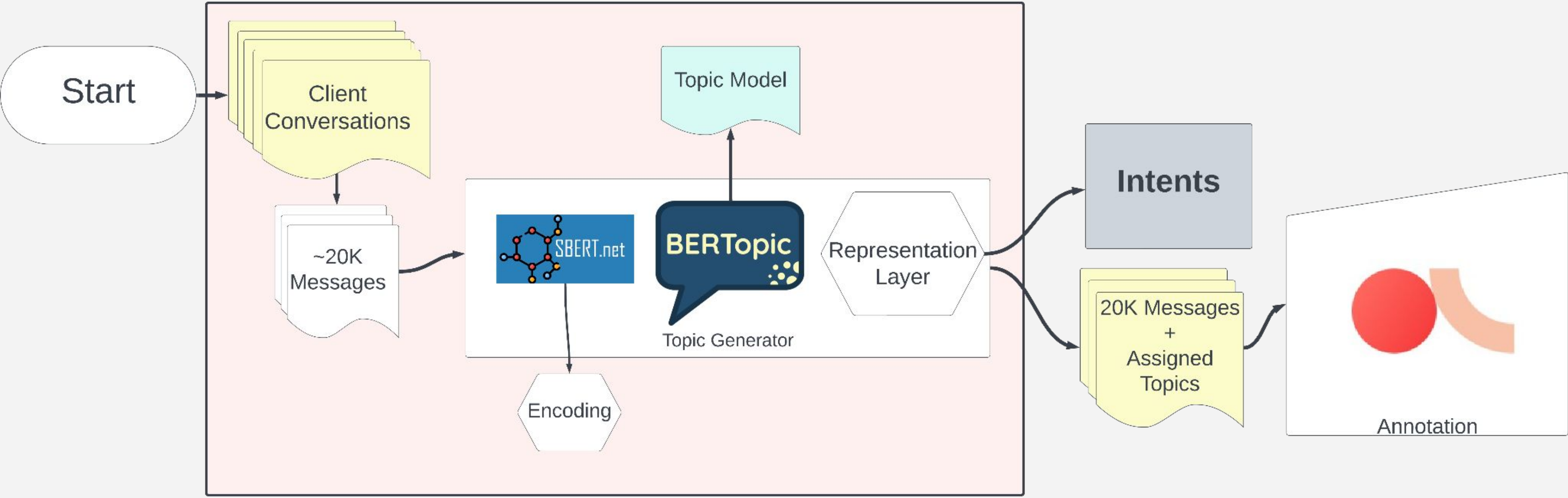
Discovery



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Topic Modeling using BERTopic

Input Text → Sentence Representation → Dimensionality Reduction → Clustering → Cluster Naming → Topics

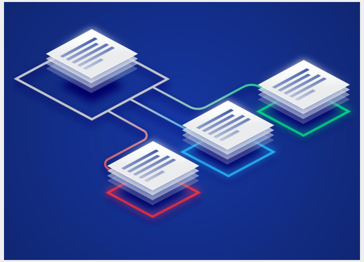
Unlabeled Messages

SBERT.net
Sentence-Transformers

UNIFORM MANIFOLD
UMAP
APPROXIMATION & PROJECTION

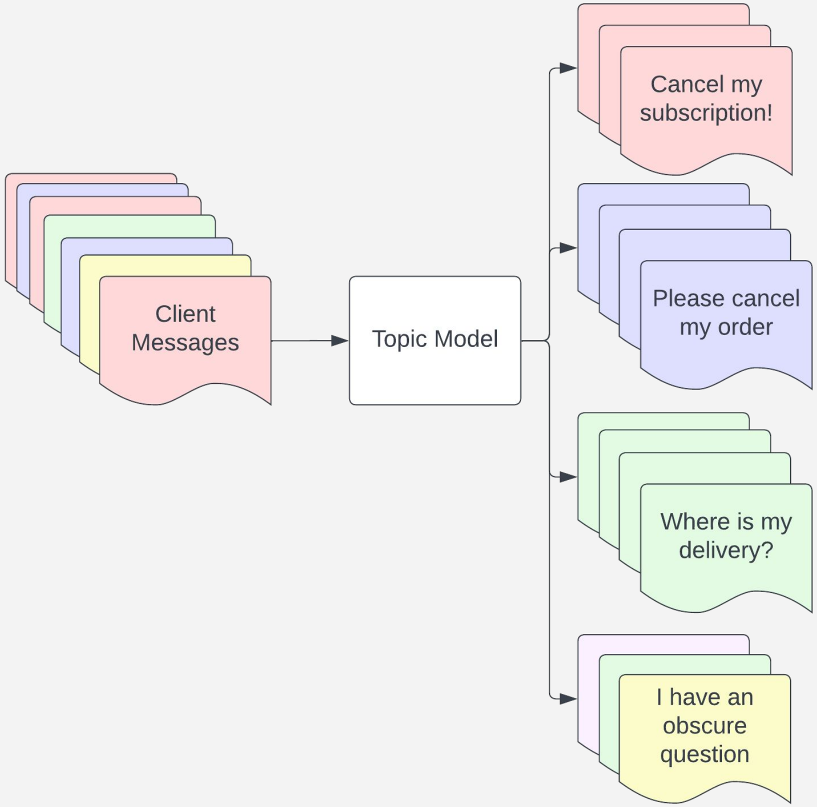
HDBSCAN

Azure
OpenAI



Discovery

- Topic Modeling
- Use unsupervised learning to find structure in data
- Create clusters and groups of messages
- Leverage many techniques
  - Unsupervised learning
  - Seeded topic modeling
  - Multi-aspect representation
- Generate Names for Topics
- Generate Definitions for Topics
- Output representative samples for each topic



Documents and Topics

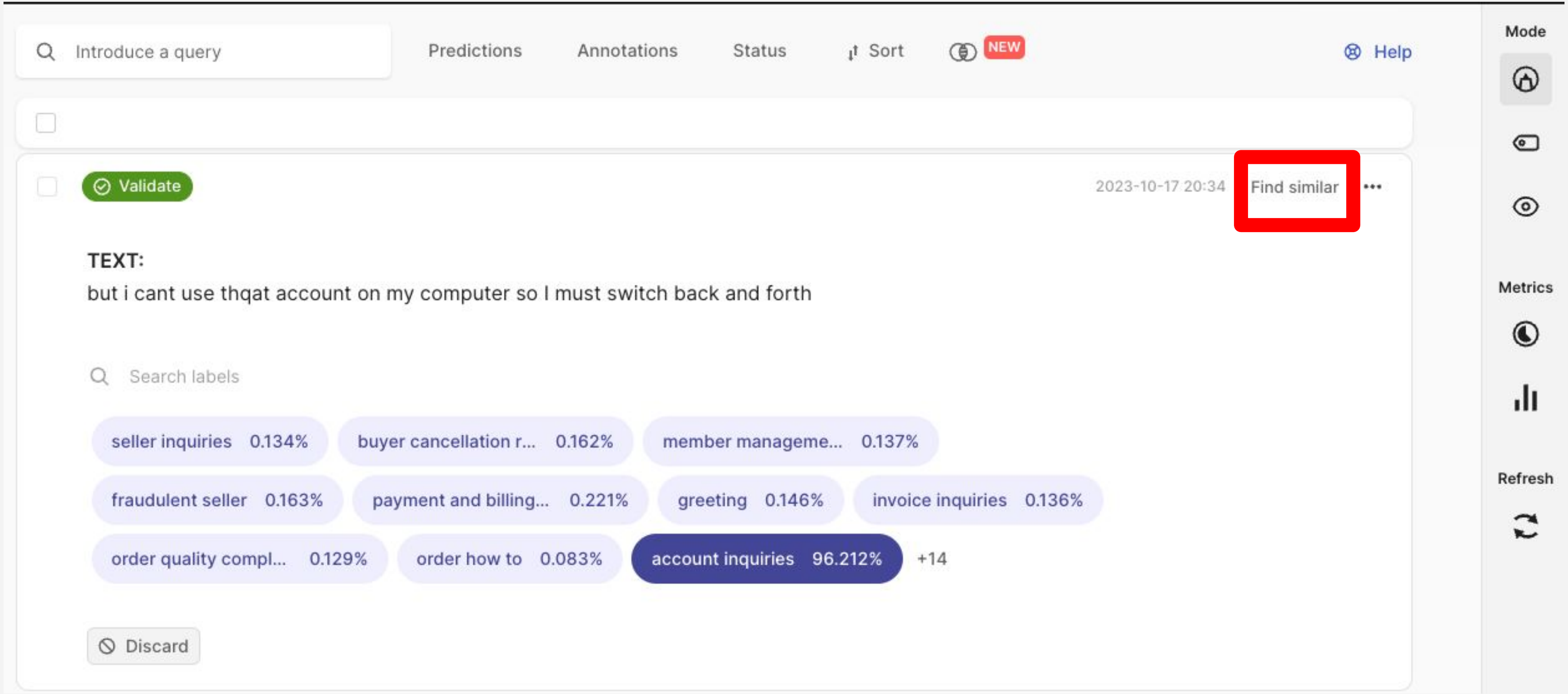
Discovery Outputs

- Number of classes
- Generated names of classes
- Generated definitions of classes
- Representative samples for each class

Gather Labeled Samples

- Validate samples in Argilla
- Find a small sample for each class
- SetFit only needs a few samples to train
- We need additional samples to validate model
- Use similar to build up dataset quickly

Label Samples Using Argilla



SetFit

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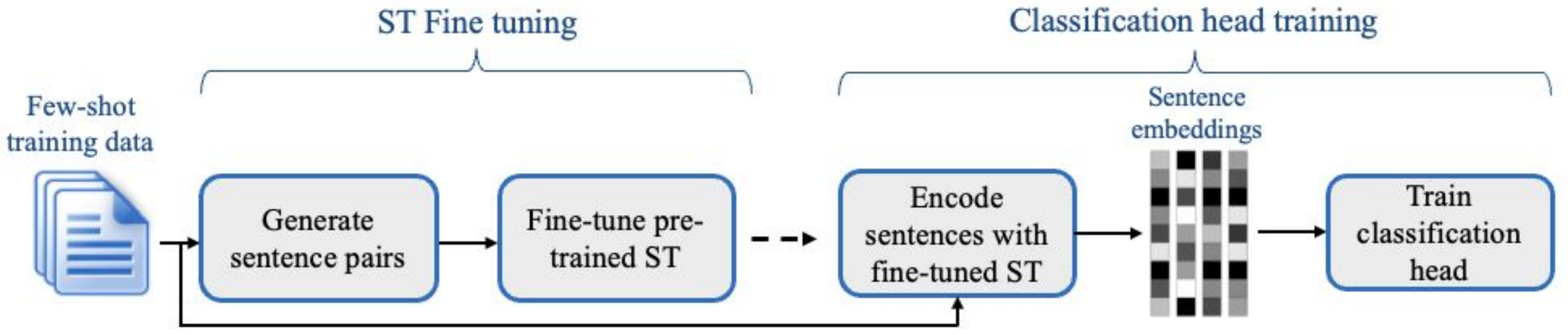
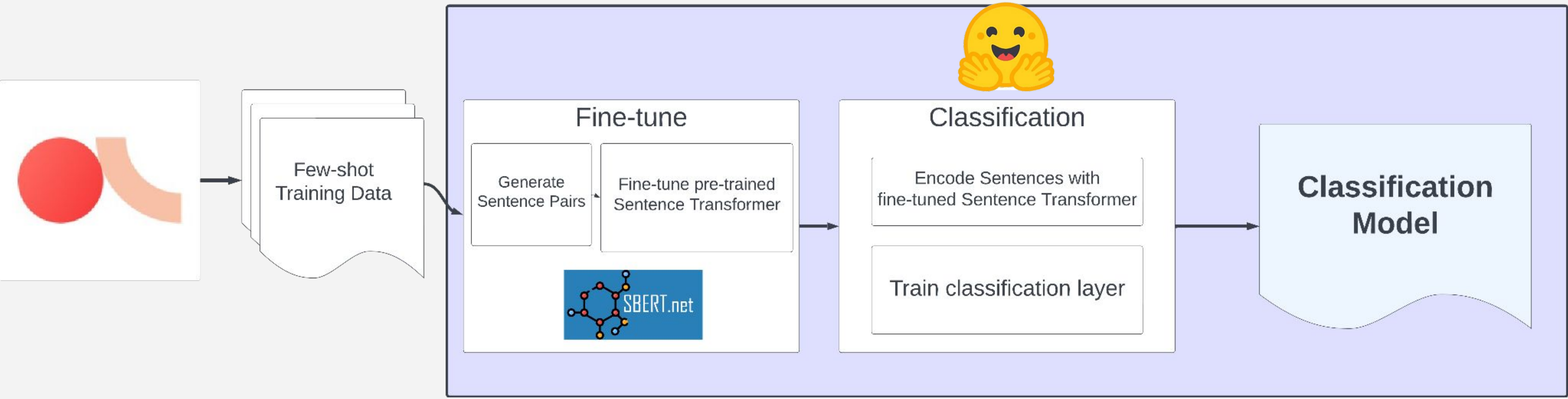
What is SetFit?

- Efficient Few-shot Learning with Sentence Transformers
- SetFit on HuggingFace
- GitHub - huggingface/setfit
- Used for multi-class text classification
- [arXiv] Efficient Few-Shot Learning Without Prompts
- Collaboration between HuggingFace and Intel



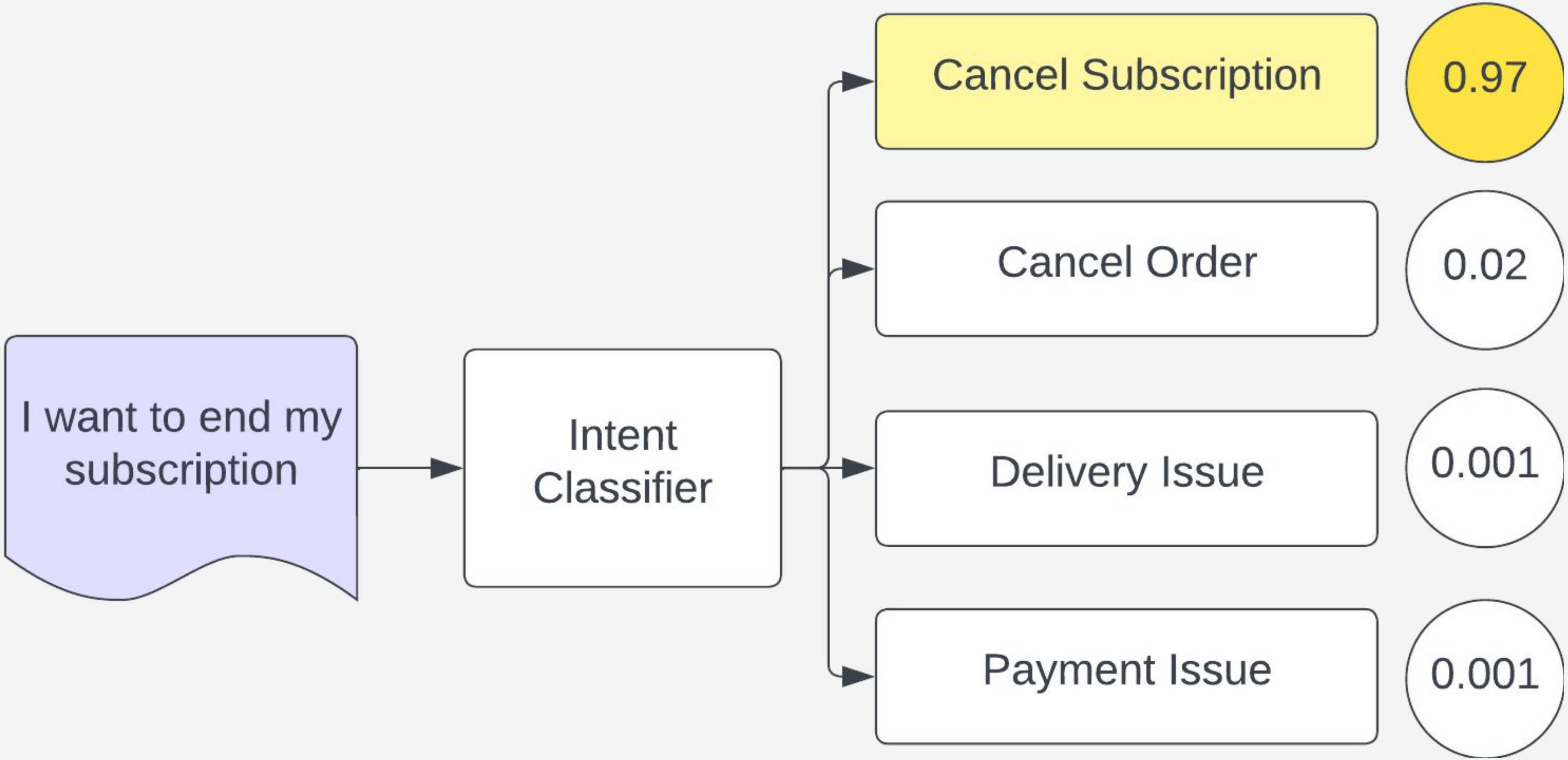
Train Model using SetFit



Why Use SetFit?

- Representation Learning
  - Capture meaningful relationships among items within sets
- Contrastive Objective Function
  - Positive pairs are pulled closer, while negative pairs are pushed apart
- Scalable
- Fast
- SetFit 1.0 was released recently with updated documentation and functionality - thanks to Tom Aarsen!
- No prompting required
- High performance achieved with few examples
- Elegant
- Supported by HuggingFace

Supervised Text Classifier



Batch Inference

- Run on hold-out dataset to examine classifier on the message-level
    - Create classification report
    - Create confusion matrix
- Error Analysis
    - Examine outputs with probabilities in Argilla

If model version passes message-level criteria:

- Run on unseen conversation data to examine classifier on conversation-level

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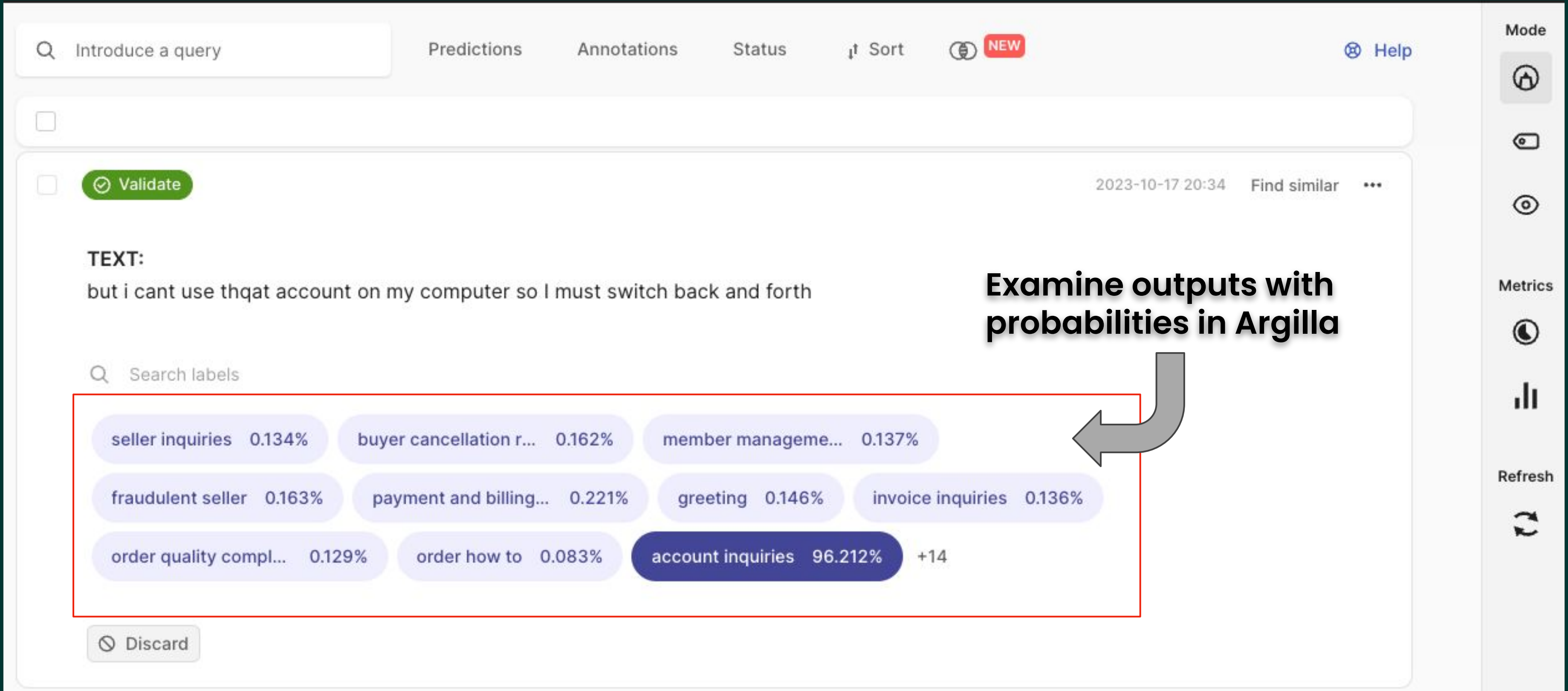
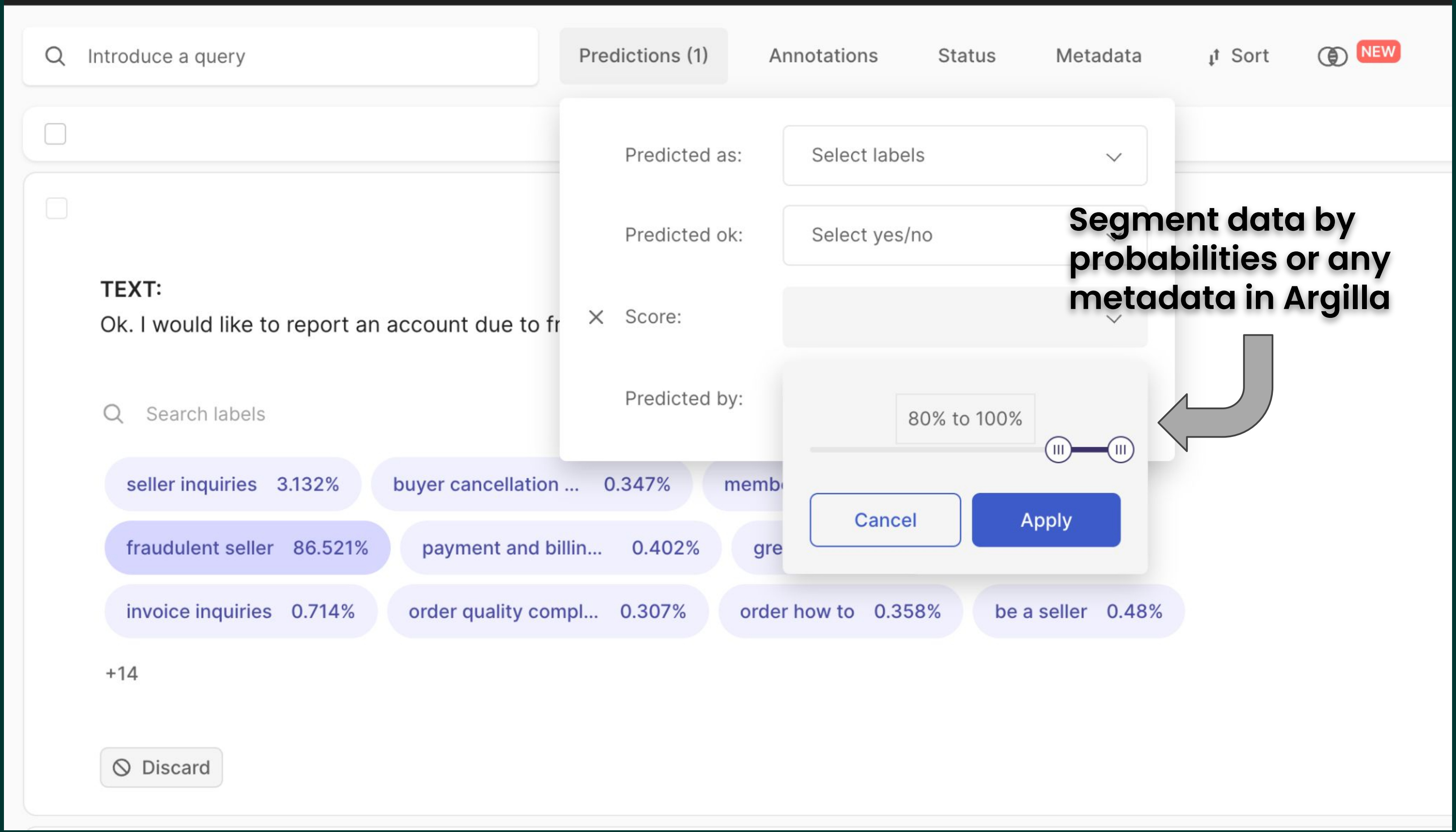
Examine outputs with probabilities in Argilla



Segment data by probabilities or any metadata in Argilla



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Evaluation

Evaluation Reminder

Coverage: What percent of conversations are assigned an intent

Precision: When an intent is predicted, is it correct?

Frequency: Does the frequency of each contact driver make sense?

Must be evaluated on both the message-level and conversation-level

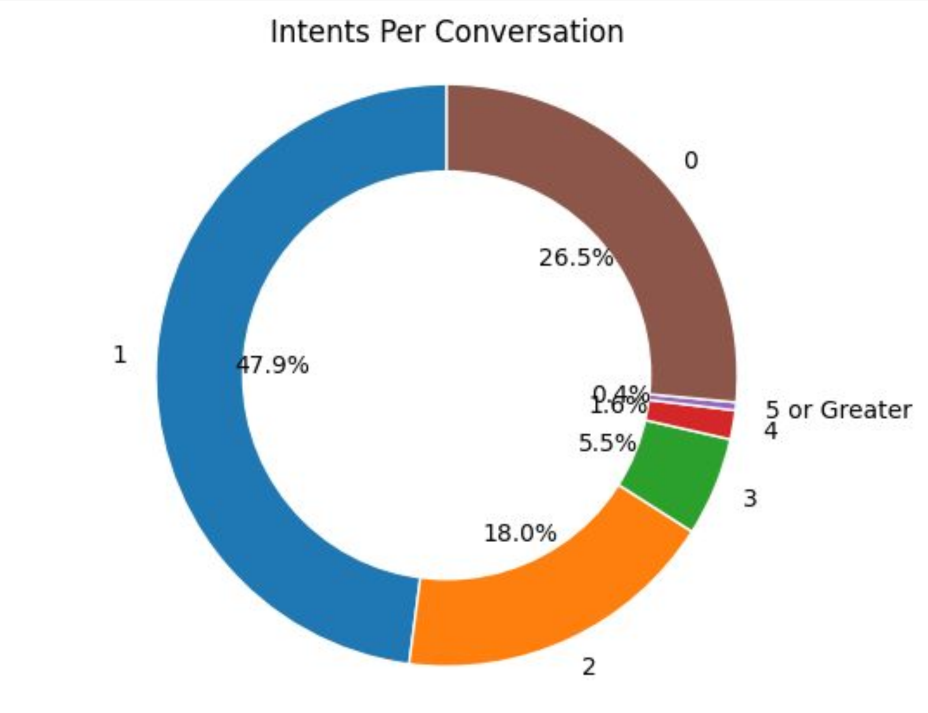
Challenge

How do you evaluate a model on unseen data if you don’t have labels?

- Look at aggregate metrics
- Use human annotators
- Use an LLM

Aggregate Metrics

- Coverage
- Intents per Conversation
- Class Frequency



LLM Validator

- A generative system that can be used to validate training data and validate predictions

Prompt Example: *"Given {class_name} is defined as {definition}, with the following {examples} classify the following message as YES if it is a {class_name} and NO otherwise:"*

- `class_name` is the accepted class name
- `definition` is the accepted class definition
- `examples` are examples for that topic

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Thresholding

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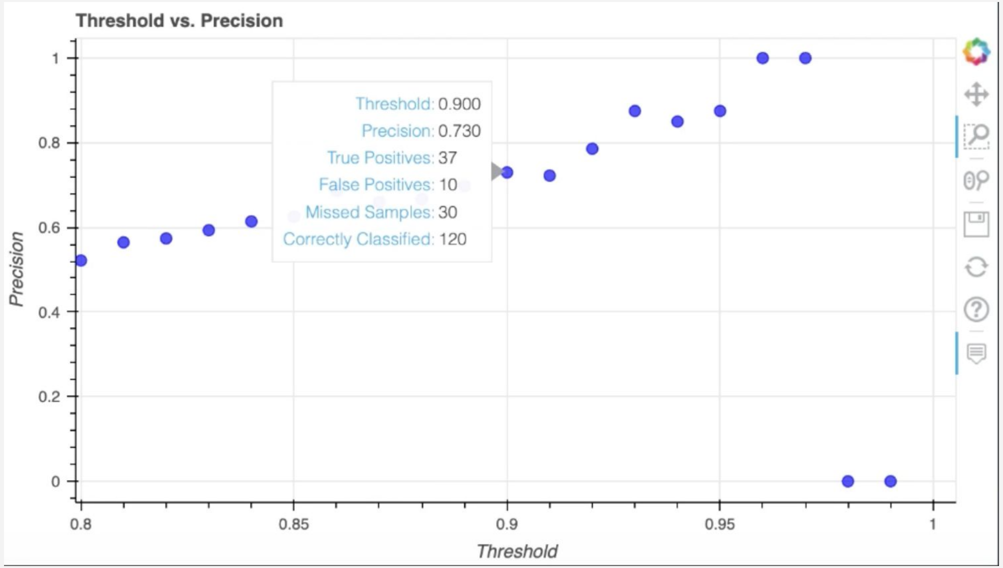
Examining Threshold

- Text - Sample
- Predicted Class
- Predicted Probability
- Label

The Art of Thresholding

- Simply maximizing some metric or function does not work in practice
- All errors are not equal
- Get your hands dirty
- Examine:
  - True Positives
  - False Positives
  - False Negatives
- Set threshold above where errors get flagrant



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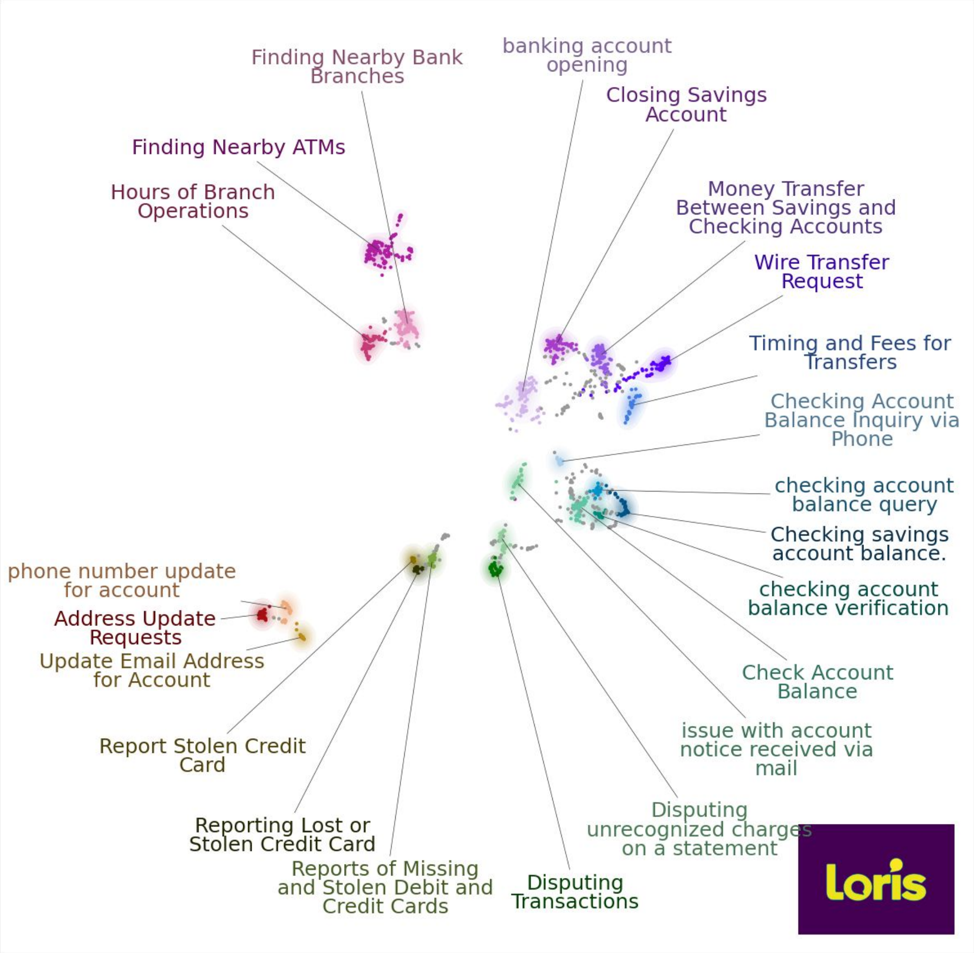
Demo

Demo

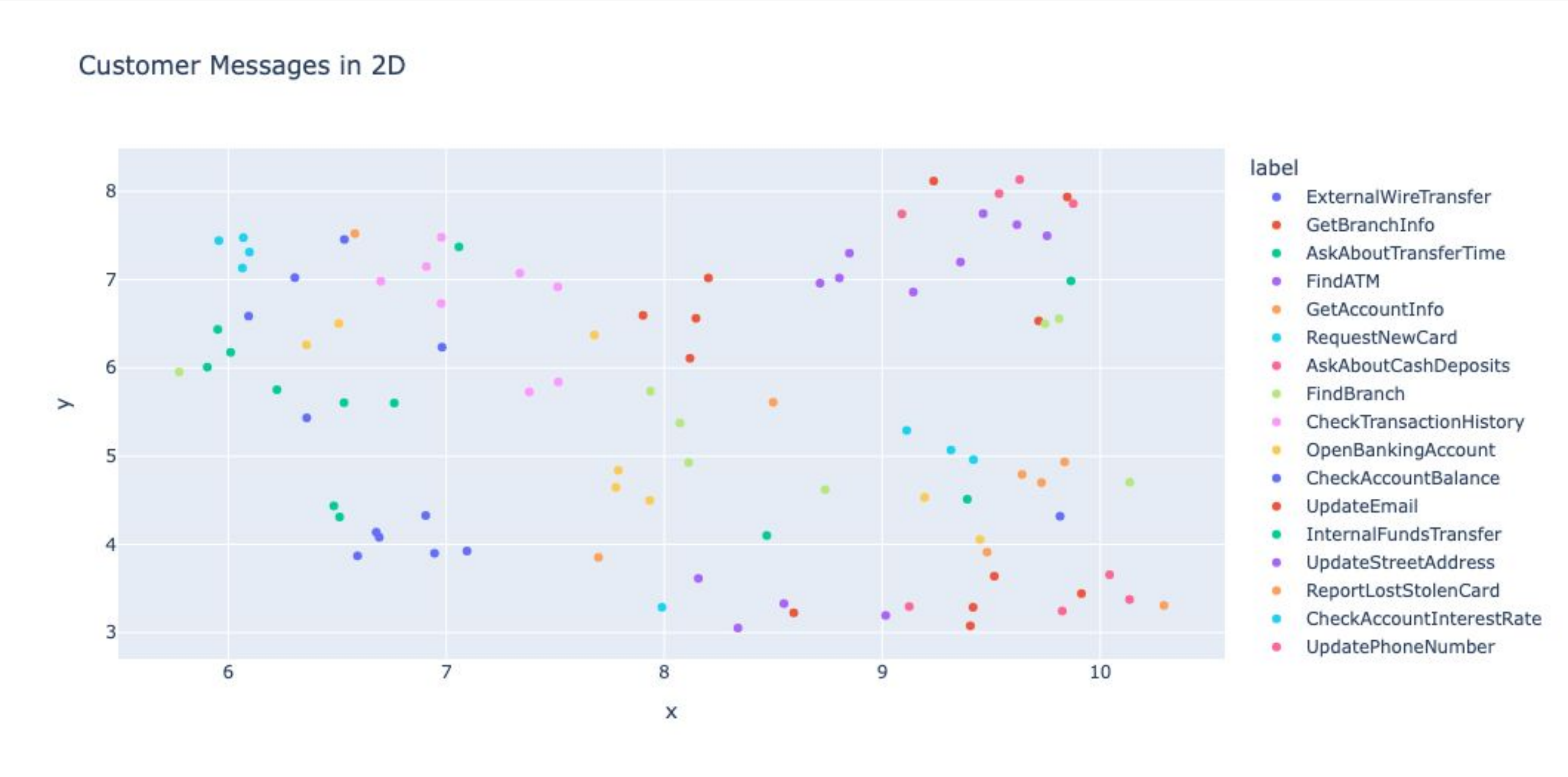
- Dataset: Dialogue State Tracking Challenge from ACL 2023
    - Banking Data
- Explore Data
- Run BERTopic
    - Simulate Intent Discovery
- Train Setfit Model
- Evaluate Classifier
- Visualize what's happening
- Demo Notebooks:
    - Topic Modeling using BERTopic
    - SetFit Train Classifier

Demo - Loris

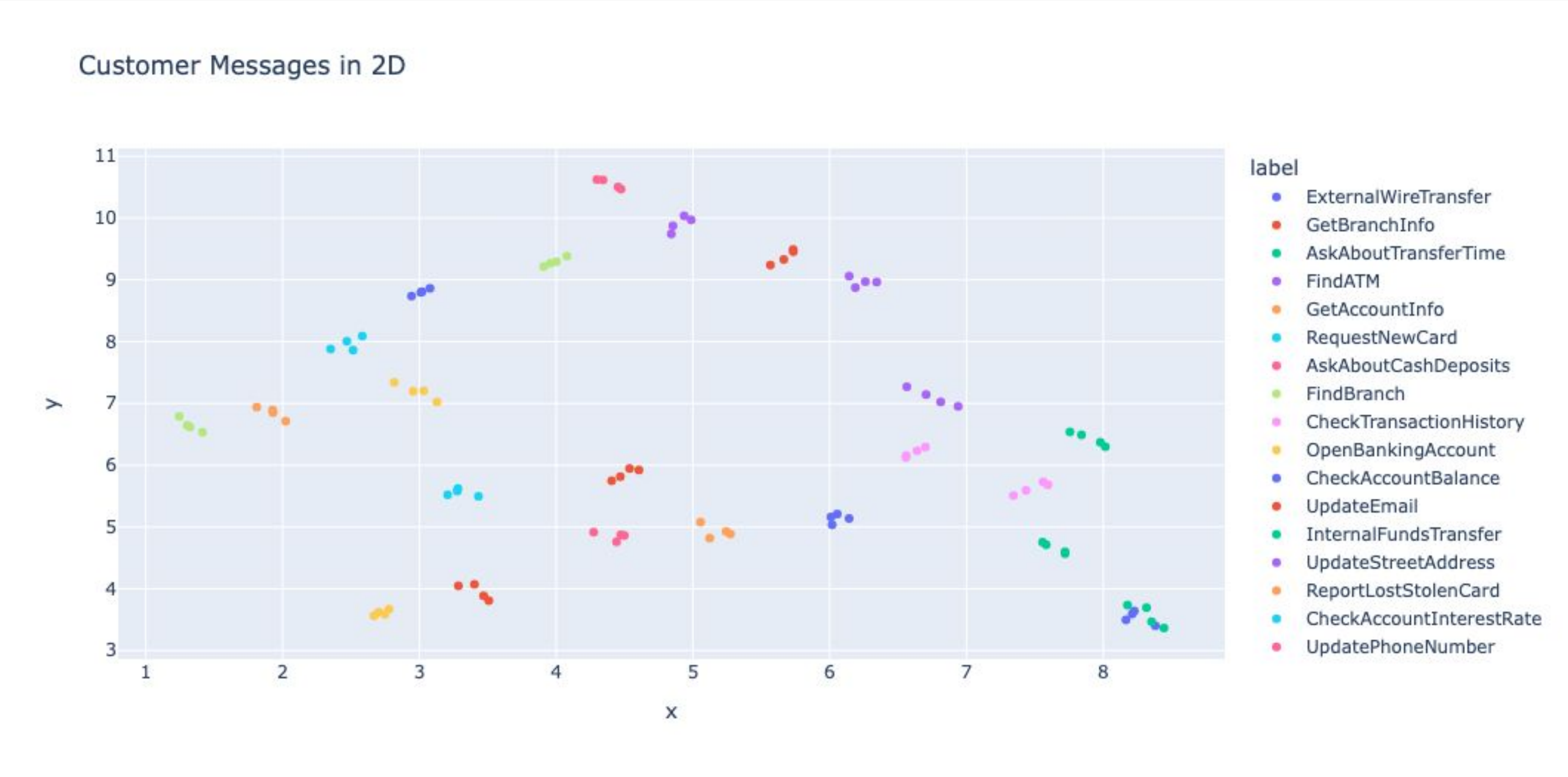
Topics labeled with `KeyBERTInspired + OpenAI GPT-3.5`



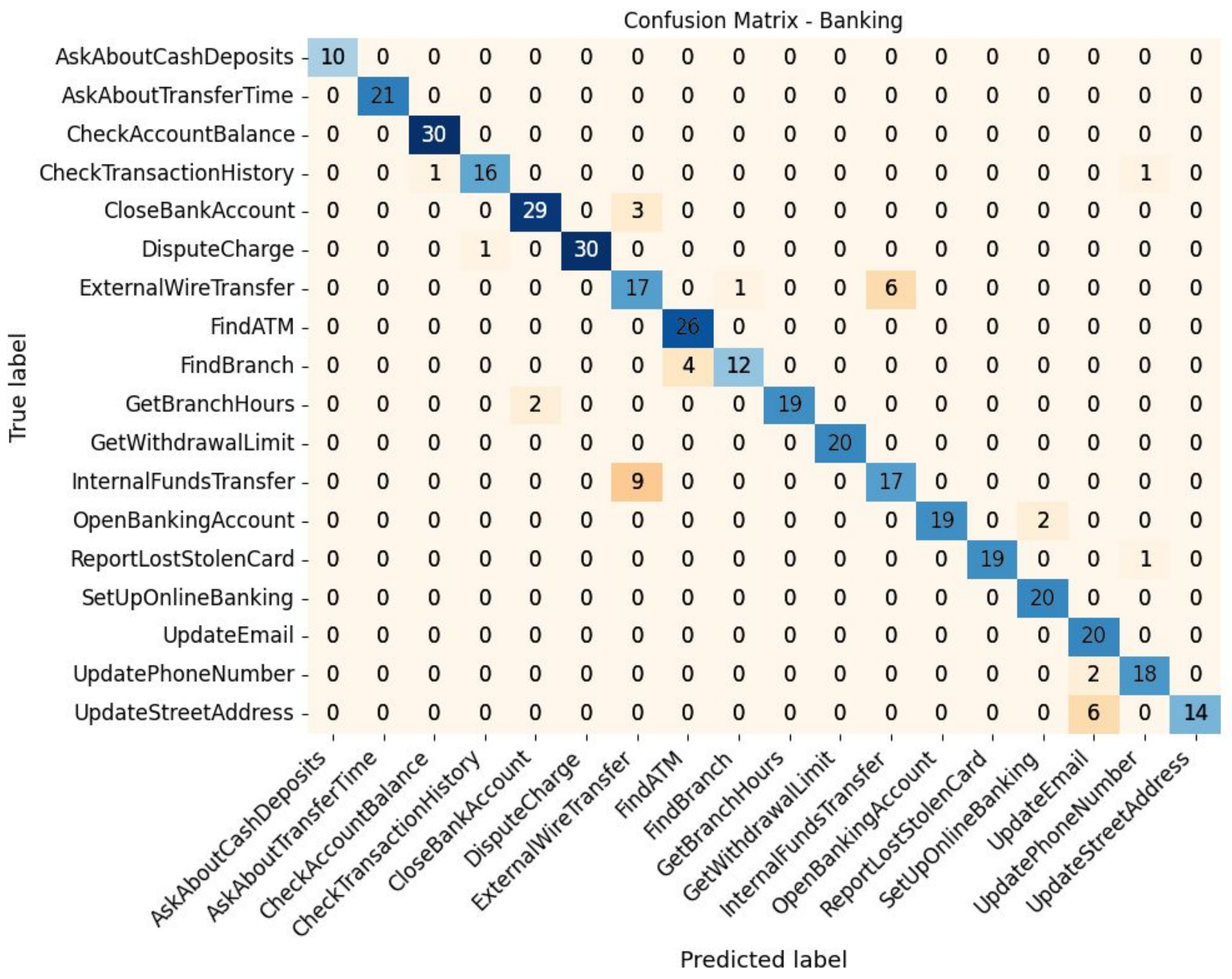
Training Data Before Fine-Tuning



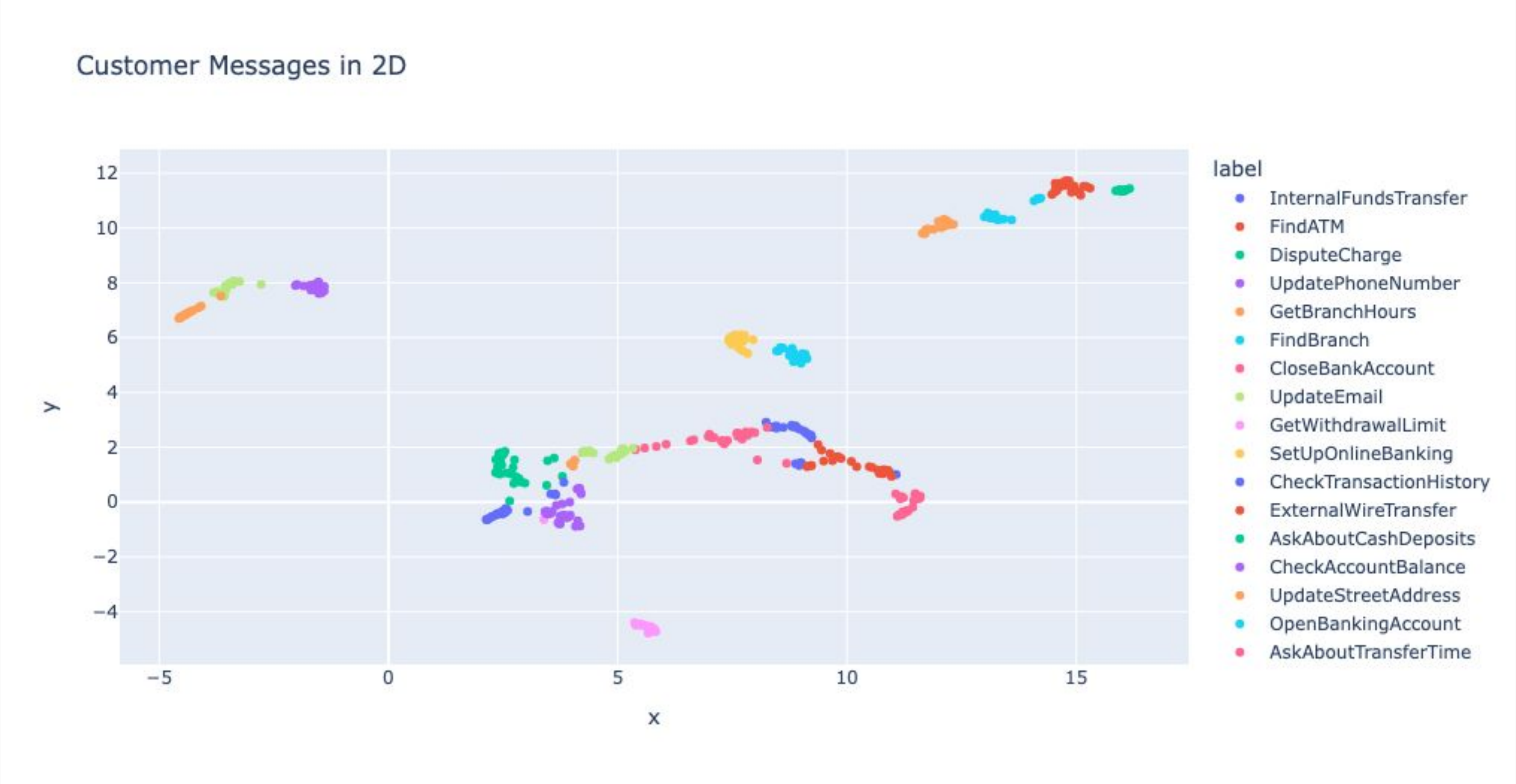
Training Data After Fine-Tuning



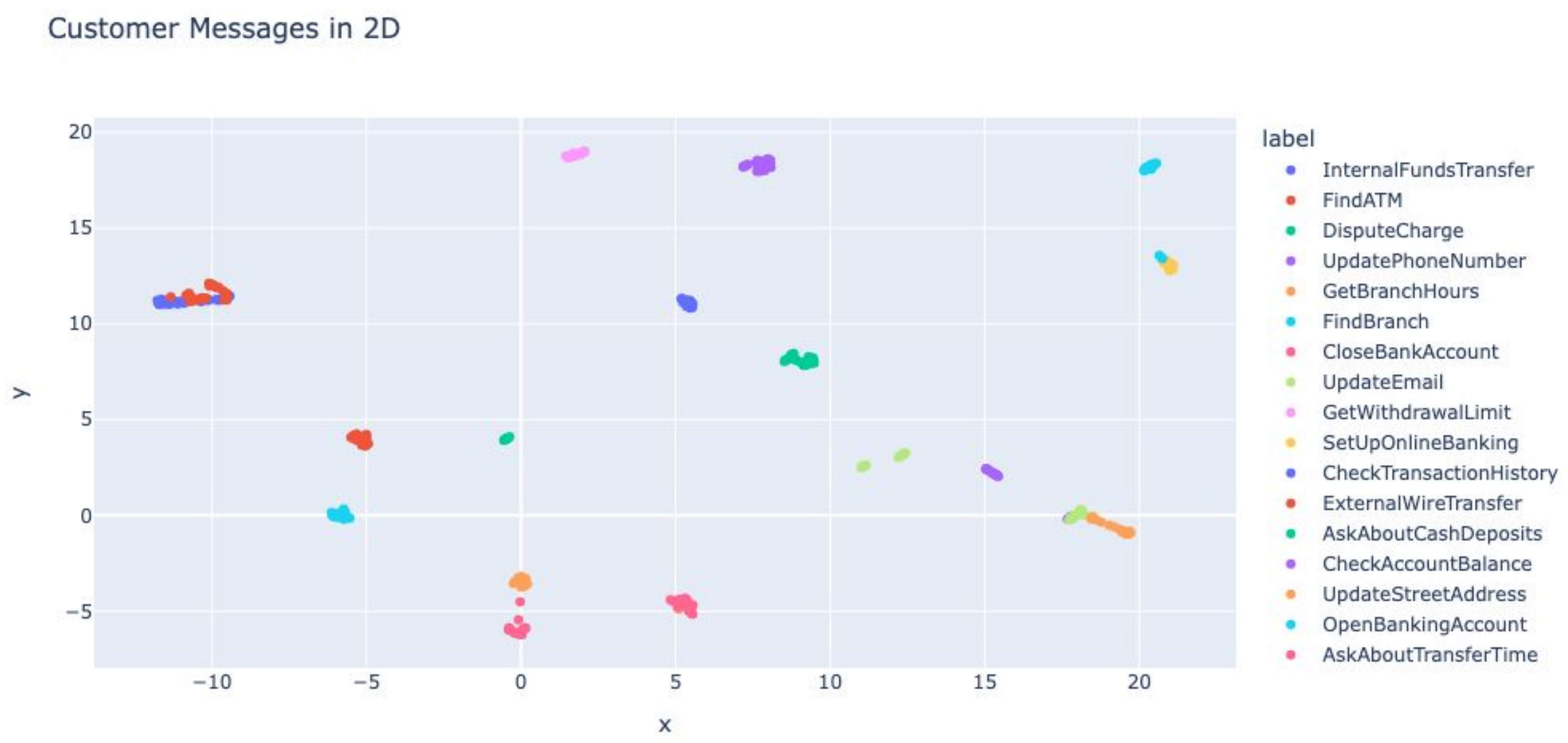
Evaluation


Confusion Matrix - Banking
True label
Predicted label
AskAboutCashDeposits 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
AskAboutTransferTime 0 21 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
CheckAccountBalance 0 0 30 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
CheckTransactionHistory 0 0 1 16 0 0 0 0 0 0 0 0 0 0 0 0 1 0
CloseBankAccount 0 0 0 0 29 0 3 0 0 0 0 0 0 0 0 0 0 0
DisputeCharge 0 0 0 1 0 30 0 0 0 0 0 0 0 0 0 0 0 0
ExternalWireTransfer 0 0 0 0 0 0 17 0 1 0 0 6 0 0 0 0 0 0
FindATM 0 0 0 0 0 0 0 26 0 0 0 0 0 0 0 0 0 0
FindBranch 0 0 0 0 0 0 0 4 12 0 0 0 0 0 0 0 0 0
GetBranchHours 0 0 0 0 2 0 0 0 0 19 0 0 0 0 0 0 0 0
GetWithdrawalLimit 0 0 0 0 0 0 0 0 0 0 20 0 0 0 0 0 0 0
InternalFundsTransfer 0 0 0 0 0 0 9 0 0 0 0 17 0 0 0 0 0 0
OpenBankingAccount 0 0 0 0 0 0 0 0 0 0 0 0 19 0 2 0 0 0
ReportLostStolenCard 0 0 0 0 0 0 0 0 0 0 0 0 0 19 0 0 1 0
SetUpOnlineBanking 0 0 0 0 0 0 0 0 0 0 0 0 0 0 20 0 0 0
UpdateEmail 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 20 0 0
UpdatePhoneNumber 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 18 0
UpdateStreetAddress 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 6 0 14
AskAboutCashDeposits
AskAboutTransferTime
CheckAccountBalance
CheckTransactionHistory
CloseBankAccount
DisputeCharge
ExternalWireTransfer
FindATM
FindBranch
GetBranchHours
GetWithdrawalLimit
InternalFundsTransfer
OpenBankingAccount
ReportLostStolenCard
SetUpOnlineBanking
UpdateEmail
UpdatePhoneNumber
UpdateStreetAddress

Evaluation Data Before Fine-Tuning



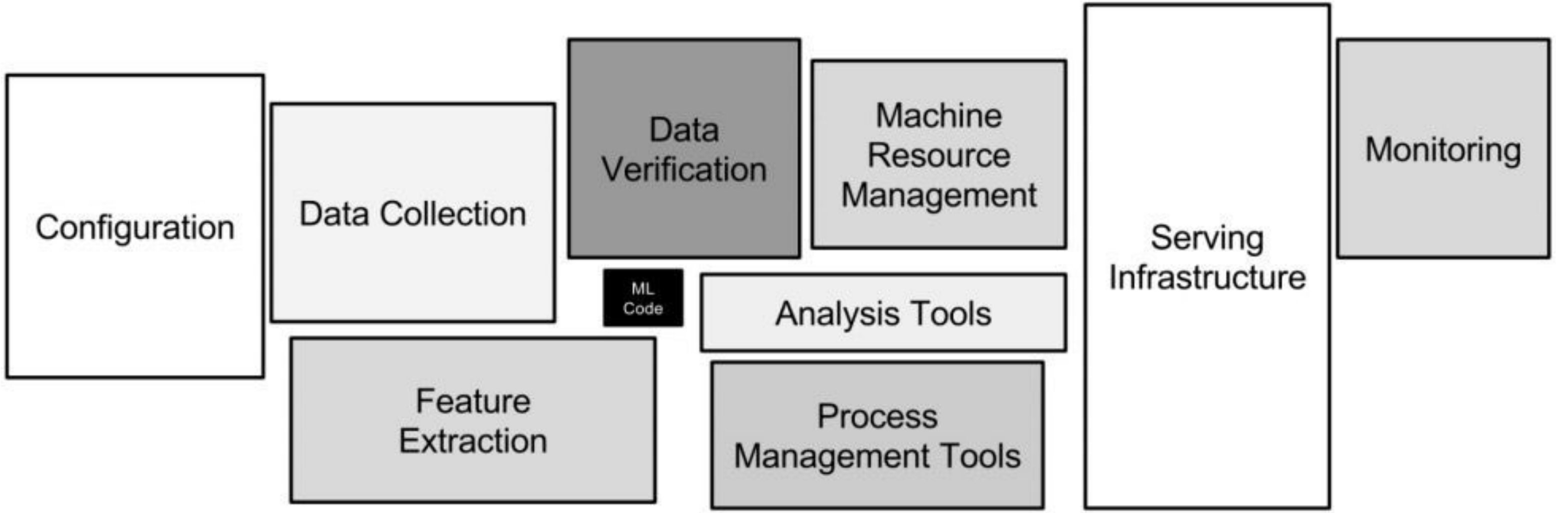
Evaluation Data After Fine-Tuning



Conclusion

Hidden Technical Debt in Machine Learning Systems

D. Sculley, Gary Holt, Daniel Golovin, Eugene Davydov, Todd Phillips
{dsculley,gholt,dgg,edavydov,toddphillips}@google.com
Google, Inc.



Learnings

- Understand the problem and use-case deeply
    - Keep revisiting the problem and underlying need
- Use the learnings from other models
    - Create sanity checks - eyeball test sets
- Incorporating classes to ignore improves performance
- Incorporating heuristics can really help
- Training a model is small part
- Creating high quality datasets can help you long term

Learnings

- Segmenting data is a must
- Threshold tuning is almost always needed for multi-class problems
- Creating strong components is important
- You're creating a system not a model
    - Ability to modify is a requirement
- Automation and end to end is a great motivation, but know your data
    - Examine, visualize, explore
    - Include human in the loop when necessary

Argilla

DataMapPlot

W&B

SBERT.net

Sentence-Transformers

spaCy

BERTopic

PHOENIX

Takeaways

- Introduction to Loris
- Creating systems to help companies solve problems
  - Challenges in creating client-specific models
  - Example of how to apply NLP to solve problems
- BERTopic is a one-stop shop for topic modeling
- LLMs are great, but they are one potential solution, not the only solution
  - If you're creating a classifier, just create a classifier :)
- Combining multiple approaches often yields the best results

Q & A

Thank You!

Learning from Machine Learning

Loris.ai
Seth Levine | LinkedIn

References

- Loris.ai
- Learning from Machine Learning - YouTube
- BERTopic
- Argilla docs
- Sentence-Transformers
- SetFit
- DataMapPlot documentation
- Hidden Technical Debt in Machine Learning Systems
- It’s the Golden Age of Natural Language Processing, So Why Can’t Chatbots Solve More Problems?
- Getting Machine Learning Projects from Idea to Execution

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Learning from Machine Learning

Learning from Machine Learning

Loris CoPilot

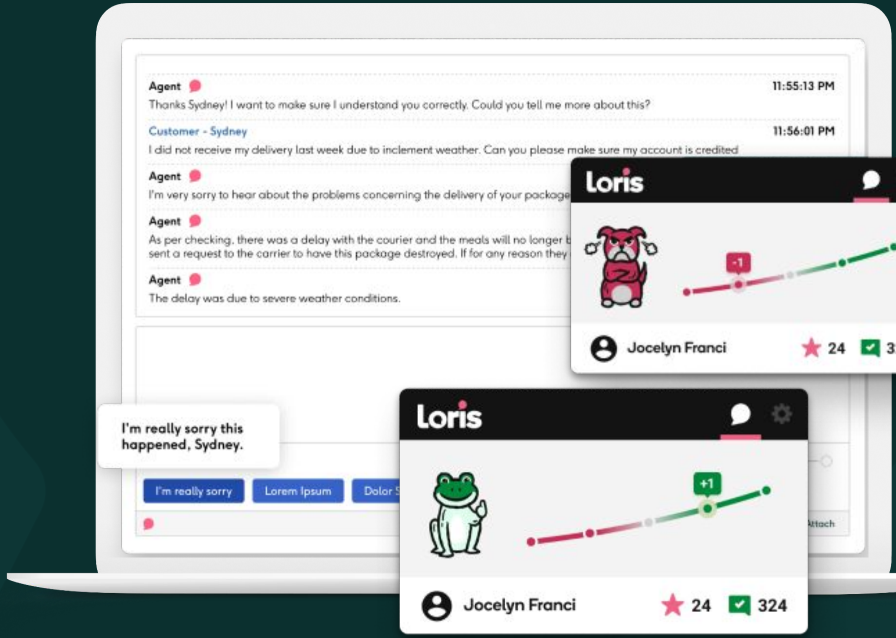
Real-time Agent Assistance

Live agent guidance & feedback

- Uses natural language AI to categorize customer conversations and identify contact drivers
- Provides CSAT score prediction
- Pinpoints both common and emerging areas of friction

Gives leaders

- Single, objective CX benchmarks
- Complete transparency into issues
- Ability to make better use of existing data
- Power to improve CX across multiple functions: product, marketing, customer service, etc.



Loris CQA

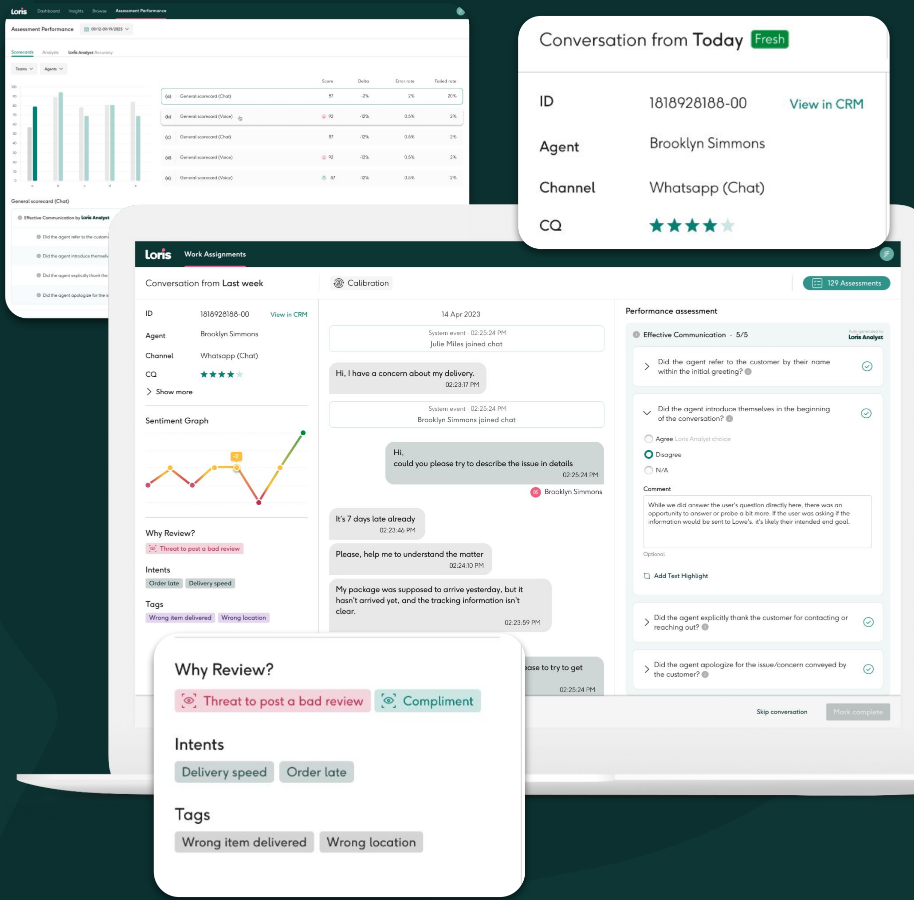
Conversational Quality Assurance

Agent quality & coaching solution

- Analyzes all your customer interactions
- Surfaces most recent & relevant conversations for review
- Automatically scores agent conversation skills
- Provides agent performance & coaching summaries

Helps QA and Agent Managers

- Lower the cost of QA
- Improve agent performance in less time
- Increase consistency & value in QA



Loris Insights
Customer interaction analytics

CX intelligence platform

- Uses natural language AI to categorize customer conversations and identify contact drivers
- Provides CSAT score prediction
- Pinpoints both common and emerging areas of friction

Gives leaders

- Single, objective CX benchmarks
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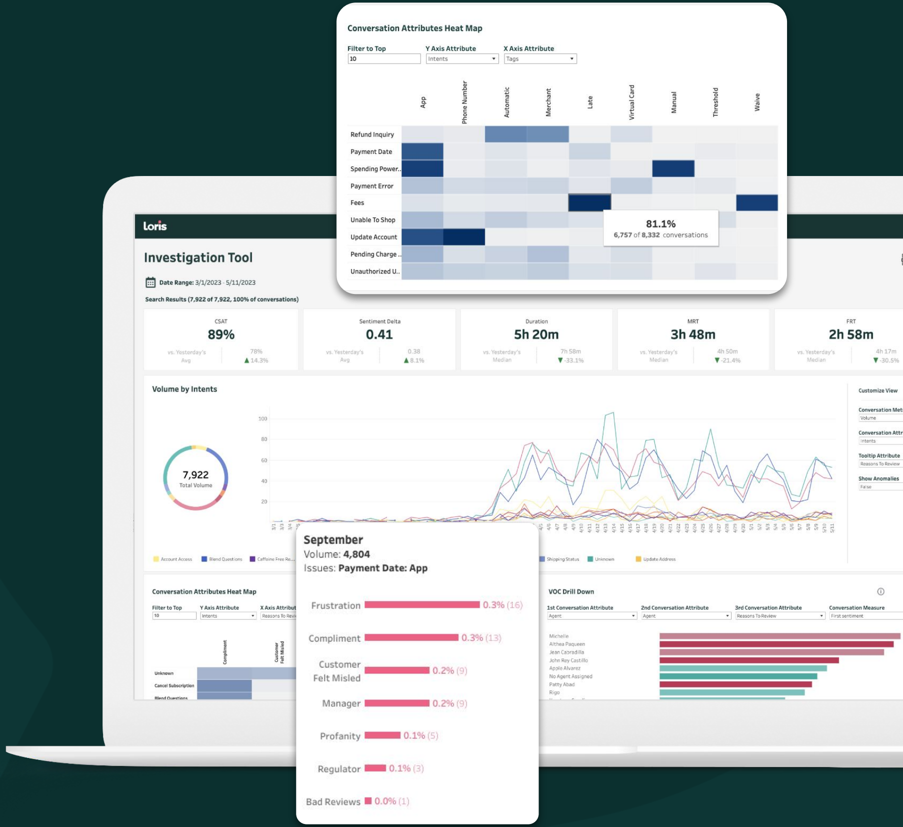
- Power to improve CX across multiple functions: product, marketing, customer service, etc.



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